

Racing with the Sun

An experimental solar electric car with remarkable performance highlights a sampling of technology transfers in the field of energy

On the morning of November 1, 1987, 25 odd-looking vehicles departed Darwin on Australia's North Coast in the inaugural World Solar Challenge Race, a competition for solar-powered autos with entries from Australia, Denmark, Germany, Japan, Pakistan, Switzerland and the United States.

Five and a half days later, General Motors' *Sunracer*, one of four American entries, crossed the finish line near Adelaide, South Australia—more than 600 miles and two and a half days ahead of its nearest competitor after a grueling, 1,950-mile run through tropic heat and humidity in northern Australia, through a thousand miles of desert heat in the Central Australia outback, and finally into a temperate climate in the last stages of the race.

The little one-seater covered the north-south transcontinental route at an average speed of 41.6 miles per hour. Its *average* speed was considerably better than the prior world speed record for land vehicles powered by direct energy from the Sun—35.22 miles per hour, a record also held by *Sunracer*.

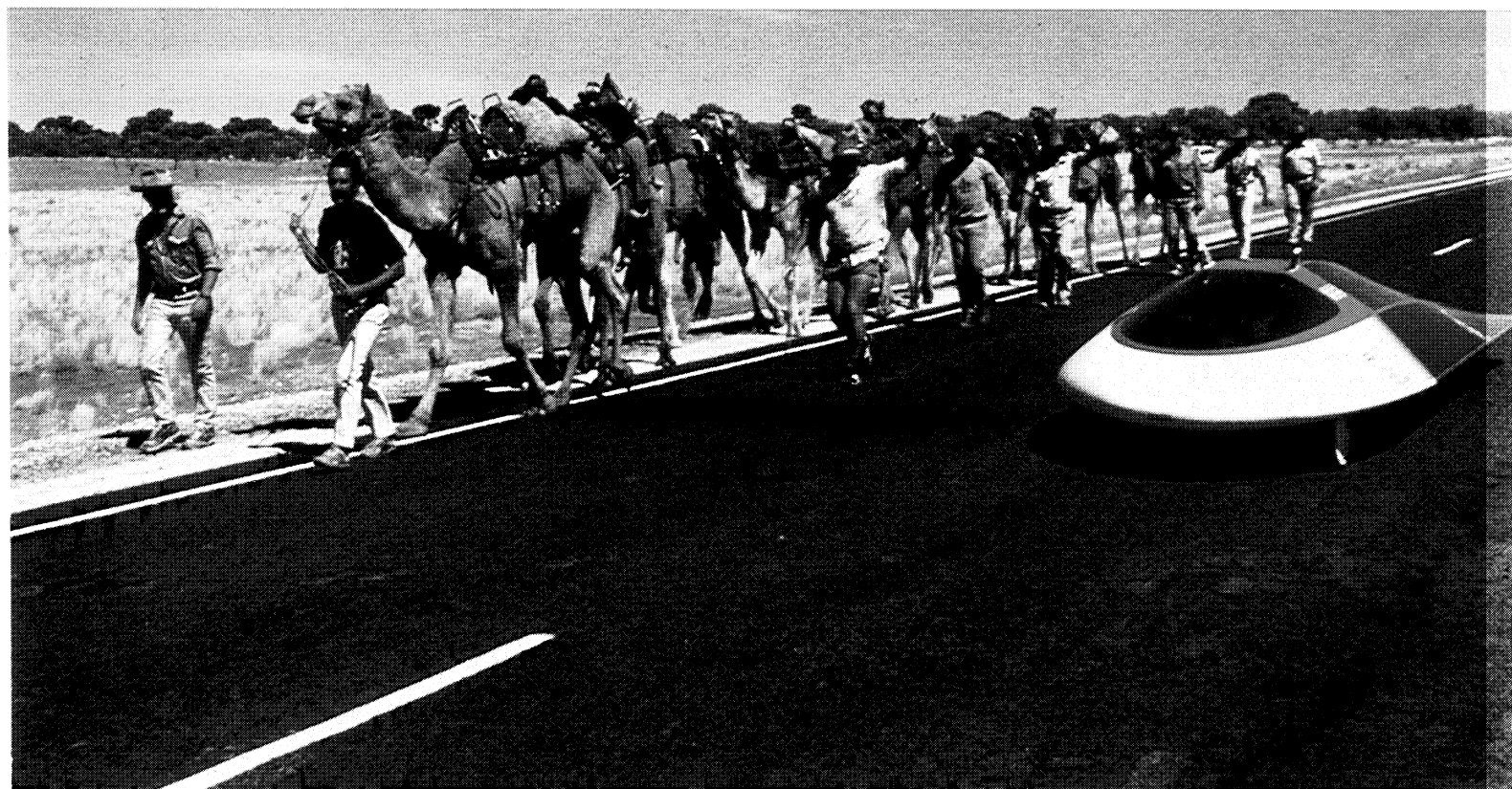
Sixteen General Motors operations and several suppliers joined forces to design, build and drive the sleek *Sunracer*. One of the prime movers was Hughes Aircraft Company, a subsidiary of GM Hughes Electronics Company and a longtime NASA contractor. Hughes designed and built the solar arrays, composed of 1,400 Hughes silicon solar cells and 3,800 gallium arsenide cells each from Applied Solar Energy Corporation and Mitsubishi Electric Corporation. These photovoltaic cells convert the Sun's rays directly into electricity. Development of photovoltaic power was pioneered by NASA and its contractors—including Hughes—and it has been used to power most of the spacecraft sent into orbit.

The *Sunracer* project embraced a number of other advanced technologies, including a revolutionary electric motor, developed by GM Research Laboratories and Delco Remy, and several aerospace-related technologies, such as microelectronics, optics, lightweight materials and communications. In addition, the vehicle was designed with the help of a NASA-developed computer program called VSAERO, used to calculate the aerodynamic characteristics of the *Sunracer*.

The *Sunracer* features a welded aluminum tube "spaceframe" chassis, designed by AeroVironment Inc., Monrovia, California, and a body of lightweight honeycomb sandwich material. The low-slung teardrop shape is designed to achieve extremely low aerodynamic drag, with low side forces during crosswinds, while providing a suitable surface for the solar cells and adequate space for the driver (six drivers alternated, four to five hours at a time, in the Solar Challenge race).

Less than 20 feet long, the *Sunracer* weighs only 547 pounds with driver. The canopy is goldplated to reflect 90 percent of the visible light and 98 percent of infrared radiation, which holds down temperatures in very hot climates.

The solar array spreads over 90 square feet of the vehicle's aft curved surface. It was de-



veloped by Hughes' Space and Communications Group, which has special expertise in fabricating curved solar arrays; a hallmark of Hughes satellites is the technique of installing solar cells on the exterior surface of a cylindrical spacecraft body, rather than on flat-panel solar wings. Although the intensity of the Sun's rays and the temperature of the environment affect output, the solar array typically operates at 150 volts, providing up to 1,500 watts of power at noon. The electricity generated flows to the motor or to the storage battery system, composed of 68 rechargeable silver zinc cells producing a total of 102 volts. The batteries weigh 60 pounds, one-fifth the weight of a lead acid battery of the same capacity. In the race, battery power was used early and late in the day to supplement the reduced solar power available at those times. ▲

Near the midway mark of the 1,950-mile trans-Australia race, the General Motors *Sunraycer* passes a camel train in Central Australia's outback. Powered by space-derived solar cell technology and incorporating a number of other aerospace technologies, the 547-pound one-seater averaged better than 41 miles an hour and finished 600 miles ahead of its nearest competitor.